1855MNRAS..15..196.

comes out 154 square seconds, and the sector between Captain Jacob's observations of 1846 and 1854, taken in connexion with a period of 75·3 years, gives an area of 153·6 square seconds for the ellipse. The elements also represent the observation of Fallows, as to position, with an error of only +44′, and that of La Caille, as to distance, with the trifling error of —″·34."

Notes on the Management of Chronometers and the Measurement of Meridian Distances. By Captain Charles F. A. Shadwell, R.N. C.B. &c. London, 8vo. 1855.

The author states that this work is mainly designed for the use of officers of the Royal Navy, but he expresses a hope that it may be perused with advantage by intelligent individuals of the Mercantile Marine. His object has been not so much to show how Chronometers may be rendered subservient to the ordinary purposes of Navigation as to exhibit their application to the advancement of Maritime Geography.

The work is divided into nine chapters, the first three of which are devoted to various preliminary details relative to the management of chronometers and to the determination of local time. In the fourth chapter the author explains the mode of ascertaining the rates of chronometers by two observations of a similar kind taken at a convenient interval. On this part of his subject he remarks :—"For the determination of the error on local mean time, it has formerly generally been the practice in the measurement of meridian distances, or on taking a departure from a port, to adopt as the starting-point the error shown by the last observation used in the determination of the rate; but inasmuch as in the deduction of the latter, we necessarily place equal confidence in both the observations, there seems to be no good reason why we should not do the same in assuming the error and adapting as our *working* error the mean of the two errors on which we have already agreed to make the rate depend.

"The *mean* error thus introduced may probably be assumed to be more accurate than either of the single elements on which it depends; while this mode of proceeding, moreover, will have the advantage of referring both the error and the rate to the same epoch."

The author remarks that this mode of viewing the subject has the advantage of simplifying the process for finding the corrections to be applied for the changes of rate which may have taken place in the transit from port to port.

The principles explained in this chapter are illustrated by a copious collection of examples. In one of these the error and rate of the chronometer are determined from observations of a *dissimilar* kind made in two places whose *difference of meridian is known.* "This example," says the author, "affords an illustration of an important remark of Raper's, 'that as the longitudes of the

1855MNRAS..15..196.

several places approach to precision, ships will employ the difference of longitude as a means of obtaining directly the *sea-rates* of their chronometers, instead of waiting to obtain harbour-rates; thus exemplifying one of the most important ends to which the perfection of hydrography can serve.' "

Upon the question with respect to the best interval for determining the rates of chronometers, the author justly remarks that if the stability of the rate could be relied upon, its value would be obtained with greater accuracy the longer the interval of time included between the observations for ascertaining the values of the error on mean time.

" In practice, however, this theoretic view is limited in its application by the impossibility of depending confidently on the steadiness of the rate over long periods, and by the consequent necessity for checking the performances of chronometers by frequent determinations of their errors, and thus breaking up the intervals on which the rates depend into short periods.

" As a matter of practice, therefore, it seems advisable when circumstances permit, that the rate of a chronometer should not depend on observations made at an interval of *less* than *five* or *more* than *ten* days. Seven days will be found a convenient average interval; and in the case of eight-day chronometers, moreover, it embraces the period affected by the whole weight of the chain.

" With the above limitations it may be laid down as a maxim that chronometers cannot be rated too often when time and opportunity permit.

" It seems advisable, moreover, when the measurement of meridian distances is in contemplation, that in so far as may be practicable, the two rates employed should depend on observations made at *equal* intervals of time; since, when the intervals are very unequal, the small errors of observation do not exercise an equal influence on the final results, and their values are unduly affected by the errors of observation attendant on the rate determined at the shorter of the two periods."

In the fifth chapter the author explains the mode of obtaining the errors and rates of chronometers by a combination of several observations taken within a convenient interval of time. The accumulations of the rate for the partial intervals form the groundwork of a series of equations of condition, which are solved by the method of least squares. On the question with respect to the advantage attending the application of this method, the author remarks, that " although in most cases the mean arithmetic error corresponding to the mean of the times of observation may be considered as sufficiently accurate and convenient for practice; yet in cases where an examination of the observations seems to indicate considerable instability or fluctuation of rate during the period of rating, and when the computer does not object to the additional labour involved in the latter more elaborate process, there is no doubt its results will usually be more satisfactory, and

1855MNRAS..15..198S

certainly more correct, while it will fully repay the extra trouble employed in its manipulation."

In the sixth chapter the author treats of the chronometric determination of meridian distances, explaining the different hypotheses which have been adopted for finding the variation of the rate during the voyage between the two places where the rate has been ascertained. The following chapter contains a copious collection of examples illustrative of the principles laid down in this chapter.

In the eighth chapter, the author shows how the difference of longitude between two places may be obtained from observations giving the *errors* of the chronometers at the two stations, independently of a knowledge of their preceding or subsequent *rates.* The *error* of the chronometer is ascertained: first, upon starting from the first station; secondly, upon arriving at the second station; thirdly, upon quitting the second station; and, lastly, upon arriving again at the first station. From these data the difference of longitude between the two stations, and the rate of the chronometer for the interval included between the departure from and subsequent arrival at the first station, termed the *travelling rate,* is deduced by a formula for which the author expresses his obligation to the Rev. George Fisher.

The ninth chapter of the work is devoted to a series of precepts on the mode of recording the results of chronometric measurements.

It may be remarked, in conclusion, that the subject-matter of the work is arranged in a very lucid order, that the explanations are concise and simple, and that they are in every instance illustrated by numerous examples. Possessing such claims to consideration, the work cannot fail to prove a most valuable manual to the naval profession in general, and more especially to the class of persons whose instruction the author had mainly in view while engaged in preparing it for publication.

Captain Shea has forwarded for inspection a volume containing the record of his observations of the solar spots. The appearances and disappearances to which he refers seem to be no other than the ordinary phenomena depending on the rotation of the sun upon its axis.

An azimuth compass for determining the variation was exhibited by Baron Kleinsorgen. It is assumed that the time of noon is known or may be determined on board, and consequently the direction of the true meridian at that moment. A line is stretched across the compass-box, and this box is turned until the shadow of the line coincides with the diameter of a fixed plane a little distance below it. The pin on which the card turns is

1855MNRAS..15..199.

connected with this plane, and there is an index corresponding with the diameter which points out the reading of the compass for the time of observation. Possibly in those merchant-ships where the altitude of the sun at noon is the only observation made, such an instrument might give useful warning to the helmsman, but the method only admits of a loose approximation.

New Variable Star.

Professor Argelander, in a letter to the Editor of the *Astronomische Nachrichten* (*Astron. Nach.*, No. 9580), announces the discovery of a new variable star, namely, the star W. VI. No. 1911 = Lal. No. 13825. It is represented by Lalande as an 8^m; by Bessel, once as an 8^m, and once as an 8.9^m. Fellöcker marks it in the Catalogue as an 8^m, but upon the Chart as an 8.9^m. Bremiker makes it a 9^m. However, on the 4th and 5th of March, 1854, and on the 4th of March, 1855, it was not visible in the comet-searcher, nor was it seen in the heliometer on the 30th of the same month; but it must be admitted that on this last occasion the sky was unfavourable for observation. Two days afterwards, however, it appeared like a faint star of the 9.10^m; and on the 11th and 12th of April it shone like a faint 9^m. It is of a very ruddy colour, and, like many other variable stars of small magnitude, appears to have a period of rather more than a year. Professor Argelander proposes to call it *R Canis Minoris*, and expresses his intention of following it as long as possible.

On several Stars which have Disappeared from his Ecliptical Charts. By M. Chacornac.

"On the 7th of August, 1852, at 15^h, I placed upon one of my charts, in $21^h\ 36^m{\cdot}5$ of right ascension and $+\ 14^\circ\ 33'{\cdot}9$ of declination, a star of the seventh magnitude, which was situate between two stars of the ninth magnitude. The position of this star was obtained by comparisons made with another star of the eighth magnitude in its vicinity.

"Next day I only compared with the heavens the regions of the chart where small stars were found to be situate; unfortunately, the region in which the star of the seventh magnitude had been placed was almost entirely wanting in small stars. I did not, therefore, verify it on that day, expecting on a future occasion to fill it up with small stars, and to re-observe at the same time the star which I had placed there.

"On the 20th of the same month, having finished this chart, I was very much surprised not to find again the star of the seventh magnitude, while those of the ninth magnitude were found to be perfectly in the place which my chart assigned to